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Auto Ownership by Households in Mid-1964: Influences of Income and Other Socioeconomic Factors

THIS article presents an analysis of automobile ownership by households in the United States in mid-1964. It provides cross-sectional information on auto ownership according to selected household characteristics and, by means of multiple regressions, measures the contribution of these characteristics to the likelihood of ownership.

Five categories of ownership were examined: ownership of one or more cars, of two or more cars, of cars less than 3 years old, of cars 3 to 8 years old, and of cars over 8 years old. Six household characteristics were studied for their effects on automobile ownership: household income, age of the household head, employment status of the household head, housing tenure (homeowner versus renter), region of residence, and place of residence. The study is based on data from a sample of more than 15,000 households collected in July 1964 by the Bureau of the Census in the *Quarterly Survey of Intentions*.

This study is one of several undertaken by the Office of Business Economics for the Interagency Economic Growth Project.[1]

This article shows how household auto ownership is affected by income and other household characteristics. The effects are measured both before and after adjustment. The unadjusted measures are the actual differences from the U.S. average (mean) of auto ownership rates for classes of households. The adjusted measures are the differences after the effects of one or more other factors in the analysis are held constant.

Adjustments are important because of the intercorrelation that exists among the characteristics. Households classified according to one characteristic may contain a disproportionate number of households with another characteristic; for example, among upper income households there is a greater prevalence of entrepreneurs and homeowners, who have business and other special needs for autos. Consequently, when households are classified solely by income, the higher ownership rates apparent for upper income groups will reflect the effects of employment status and housing tenure as well as the effect of income.

The major analytical tool used in this article is multivariate analysis carried out by least squares multiple regressions using "dummy" variables.[2] This procedure has several advantages over reliance on cross-classification alone. First, the interpretation of cross-classified data becomes increasingly cumbersome as additional characteristics are introduced. Second, the coefficients of the explanatory variables provide quantitative measures of the variation of automobile ownership by household classes according to each characteristic, after adjustment for the effects of other characteristics in the analysis. Third, the coefficients of multiple determination indicate the importance of the characteristics singly and jointly, while the coefficients of partial determination indicate the incremental importance of each characteristic. Furthermore, all coefficients can be subjected to tests of significance.

Household ownership of autos

Table 1 presents tabulations of households and auto ownership in mid-1964 according to selected household characteristics. Auto ownership rates, derived from the coefficients of the explanatory variables, were used in conjunction with a Bureau of the Census estimate of the total number of households to obtain the figures on auto-owning households and on auto stock.

Table 1 shows that in mid-1964 households owned 59 million cars. Of the Nation's 56 million households, 43 million, or 77 percent, owned one or more cars. About 12 million households, or 22 percent, owned two or more cars. About 15 million households owned at least one car less than 3 years old; for 17½ million households, the latest model cars were between 3 and 8 years old; the remaining 10½ million car-owning households had cars that were all 8 or more years old. Some broad relationships between ownership rates and household income are illustrated in chart 10.

The relationship and some limitations

As was noted above, this study relates five types of automobile ownership by households to six household characteristics. The relationships state that the probability of a specific type of auto ownership is dependent upon a household's income, the age and em-

NOTE: The author is indebted to Emanuel Melichar of the Federal Reserve Board and to Harold W. Watts of the Office of Economic Opportunity for criticism and advice in the course of this study. Neither of these persons is responsible for the conclusions reached in this study.

1. A previous article in this series used cross-sectional data from the 1960 Census of Population to analyze the characteristics of auto-owning households: C. S. Friedman, "Stock of Passenger Cars: Postwar Growth and Distribution," SURVEY OF CURRENT BUSINESS, September 1963, pp. 20-24. Other studies on household automobile ownership include M. E. Kreinin and C. A. Lininger, "Ownership and Purchases of New Cars in the United States," *International Economic Review*, September 1963, pp. 310-323, and D. S. Projector and G. S. Weiss, "Survey of Financial Characteristics of Consumers," *Federal Reserve Technical Paper*, August 1966.

2. See E. Melichar, "Least Squares Analysis of Economic Survey Data," *1965 Proceedings of the Business and Economics Statistics Section*, American Statistical Association. See also J. N. Morgan, H. H. Wachtel, W. J. Cohen, and H. E. Brazer, "Income and Welfare in the United States," McGraw-Hill, 1962, pp. 508-511, and D. B. Suits, "Use of Dummy Variables in Regression Equations," *Journal of the American Statistical Association*, December 1957, pp. 548-551.

ployment status of its head, its housing tenure, its region, and its place of residence.

Each of the six household characteristics may affect the probability of auto ownership. Income is basic to the purchase and maintenence of an auto. The need for transportation—for employment, social, and recreational purposes—should vary among age groups. The self-employed may need a car for business purposes, and those who are not gainfully employed are less likely than the employed to own a car. Unlike the homeowner, the apartment renter frequently finds auto ownership relatively expensive because of the cost of parking. Region and place of residence are obviously related to the availability and cost of competing forms of transportation.

Many limitations of this study should be kept in mind. In the first place, the selection of the characteristics was dictated to a large extent by the availability of the data. Information on other characteristics, such as income in the previous year, liquid assets, size of households, race, education, and the number of children of driving age, was not collected in the *Quarterly Survey of Intentions*.[3] These probably would have contributed to the explanation of one or more of the types of automobile ownership. Inclusion of data for the characteristics that were not available would have affected the regression results that were obtained.

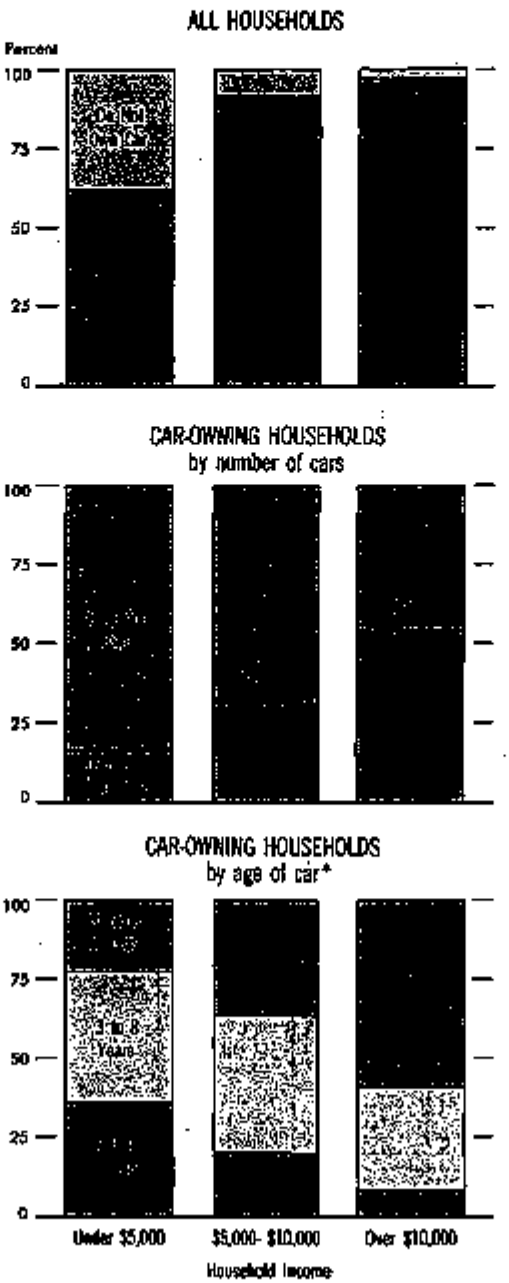
Second, the regression coefficients also have errors due to sampling variability and to intercorrelation among the variables. Third, interaction among the characteristics may have influenced the results.[4]

A fourth limitation is that the analysis is based on data for mid-1964 and may not be completely applicable to other periods. However, comparisons of cross-sectional data for 1957, 1960, and 1964 indicated a high degree of consistency in the patterns.

The remainder of this article is concerned with the results of regressions in the explanation of variations in automobile ownership. (For the technically oriented reader, the Appendix describes the methodology used.) The explanatory importance of the characteristics, which is described first, is presented in table 2. Unadjusted and adjusted differences from the mean auto ownership rates by classes of households, which are based on the coefficients of the explanatory variables, are given in tables 3 and 4 and in the charts.

CHART 10

Selected Aspects of Auto Ownership of Households, Classified by Household Income, Mid-1964



*Multicar households are counted once and are classified by age of latest model car.

U.S. Department of Commerce, Office of Business Economics

Results of the Regression Analysis

As may be seen in table 2, the six characteristics together explained 30 percent of the variation in the ownership of one or more cars—i.e., the coefficient of multiple determination, or R^2, equaled 0.30. Smaller proportions of the variation of other types of household automobile ownership were explained by the six characteristics jointly: 18 percent in the category of multiple car ownership, 14 percent for cars less than 3 years old, and smaller percentages for older cars (table 2, column 1). It should be noted that regressions involving "microanalysis" (use of unaggregated data such as households) are not likely to yield R^2s as high as those obtained from regressions based on aggregated data.

Of the six characteristics used in this study, household income was the most important determinant of each type of automobile ownership. In regressions in which the only explanatory variables were income-size classes, the income variables accounted for 18 percent of the variation in the ownership of one or more cars, 14 percent of multiple car ownership, and 12 percent for cars less than 3 years old (first column of table 2, top line of each section).

Column 2 shows the explanatory effect based on regressions that include household income and one other characteristic. This column also shows the effect of intercorrelation between income and other factors. For example, although income and age of head individually explained 18 percent and 9 percent of the variation in the ownership of one or more cars, their joint explanatory importance was only 20

3. Figures on the value of automobiles were also not available in this survey.

4. This study is based on the assumption of independence of the characteristics, i.e., that a given income would affect the probability of automobile ownership similarly among the young and the old, among homeowners and renters, among employees and entrepreneurs, etc. To the extent that this assumption is not valid, interaction is said to exist among two or more characteristics. Some interaction is unavoidable, and a moderate amount would not materially affect the broad results of the analysis. An examination of a cross-classification of automobile ownership by households based on a sample of about 20,000 households from the 1960 Census of Population indicated no substantial interaction.

percent. The effect of incorrelation is shown also by the sum of the R^2's of the six factors taken individually. This sum is 0.534, much higher than 0.304, which is the R^2, or full explanatory power, of the six factors combined.

One method of showing the incremental importance of the characteristics in explaining auto ownership is by computing the coefficients of partial determination (third column of table 2). These coefficients measure the ability of a characteristic to explain the variance remaining after the variance due to other characteristics in the regression is accounted for.[4] Household income explained 8 percent of the remaining variance in three categories of ownership: one or more cars, two or more cars, and cars less than 3 years old. In the explanation of ownership of one or more cars, household income was followed by place of residence and housing tenure. As can be seen in the first column, when auto ownership is related to only one characteristic at a time, the ranking is different: Employment status and age of head rank second and third.

Table 3 shows differences from mean ownership rates of one or more cars for various classes of households. The first column presents the unadjusted differences. The second column shows the differences from mean ownership rates adjusted for income, i.e., the differences by age of head, employment status of head, etc., with household income held constant. In the third column are differences by given characteristics adjusted for all five other characteristics in the study. The remaining six columns show the differences after adjustment for all possible combinations of four characteristics. Comparison of these six columns and column 3 indicates the incremental effect of each of the characteristics. A relatively large difference between a figure in any one of the last six columns and that in column 3 indicates that the characteristic left out is important in the explanation of auto ownership of that class. Information similar to that in the first and third columns of table 3 is shown in table 4 for ownership of two or more cars and for ownership by age of car.

4. F tests indicate that almost all coefficients of multiple and partial determination were significant at the 0.01 probability level. However, the F tests used in this study should be considered only as approximations. The distribution of disturbances departs greatly from normal because of limitations due to the coding of all observations for the dependent variables as either 1 or 0.

Table 1.—Number of Households, Car Ownership, and Car-Owning Households, by Selected Household Characteristics, Mid-1964

(Millions)

Classes of households	Number of		Number of households owning				
	Households	Cars owned	One or more cars	Two or more cars	1962–64 models [1]	1957–61 models [1]	1956 and earlier models [1]
All Households	55.2	49.4	46.3	12.3	15.1	17.5	10.8
Household income							
Under $2,000	13.4	7.9	6.7	1.2	1.6	2.7	2.4
$2,000–$2,999	5.1	2.5	3.2	.3	.6	1.2	1.4
$3,000–$3,999	5.2	4.5	3.8	.6	.8	1.6	1.4
$4,000–$4,999	5.0	4.3	4.0	.7	1.1	1.7	1.2
$5,000–$5,999	6.2	5.7	5.4	1.2	1.7	2.4	1.3
$6,000–$7,499	7.0	6.9	6.4	1.9	2.2	2.9	1.3
$7,500–$9,999	7.0	10.2	8.8	2.8	2.9	2.6	1.0
$10,000–$14,999	5.8	9.0	8.1	2.6	2.9	1.8	.5
$15,000 and more	2.6	3.4	2.6	1.2	1.3	.6	.1
Age of household head							
Under 25	3.3	3.2	2.0	.4	.8	1.1	.7
25–34	9.8	11.0	8.4	2.0	2.8	3.0	2.1
35–44	11.9	14.8	10.8	3.5	3.8	4.3	2.1
45–54	11.1	13.9	9.2	3.0	3.0	3.7	1.9
55–64	9.8	9.8	7.2	2.0	2.6	2.6	1.8
65 and over	10.5	6.6	5.5	.8	1.6	2.1	2.0
Employment status of head							
Self-employed: Nonagriculture	4.9	6.6	4.4	1.7	1.9	1.7	.8
Self-employed: Agriculture	2.1	2.3	1.8	.4	.6	.8	.4
Employee	35.3	41.6	29.8	9.0	10.0	12.9	7.0
Not employed	14.0	8.9	7.3	1.2	2.0	2.9	2.4
Housing tenure							
Homeowner	34.8	42.9	29.8	10.1	11.1	12.0	6.7
Renter	21.4	10.4	13.5	2.3	4.0	5.5	3.9
Residence by region							
New England	3.6	3.9	2.8	.8	1.0	1.2	.6
Middle Atlantic	10.9	10.0	7.5	1.9	2.8	3.1	1.6
East South Central	3.5	3.4	2.5	.7	.7	1.0	.9
South Central	7.3	8.2	6.0	1.7	2.2	2.3	1.6
West South Central	5.1	5.3	4.0	1.1	1.2	1.9	1.1
East North Central	11.3	12.4	9.0	2.6	3.5	3.8	1.8
West North Central	4.4	4.9	3.6	1.0	1.1	1.5	1.0
Mountain	2.2	2.6	1.6	.6	.7	.8	.6
Pacific	7.1	8.5	5.9	2.0	2.0	2.3	1.6
Place of residence							
SMSA, central city:							
Urbanized area 10,000,000 or more	2.7	1.3	1.1	.1	.4	.5	.2
Urbanized area 30,00,000 to 9,999,999	3.8	2.9	2.3	.6	.8	1.0	.5
Urbanized area 250,000 to 2,999,999	6.5	5.0	4.0	1.3	2.0	2.5	1.5
Urbanized area under 250,000	4.1	4.2	3.1	.8	1.1	1.3	.9
SMSA, noncentral city:							
Urbanized area 3,000,000 or more	4.8	6.0	4.1	1.5	1.7	1.6	.8
Urbanized area under 3,000,000	12.8	16.4	11.3	3.9	4.3	4.5	2.4
Outside SMSA, urban	8.1	8.4	6.2	1.6	2.0	2.6	1.7
Outside SMSA, rural nonfarm	6.5	8.9	6.8	1.7	2.2	2.6	2.0
Outside SMSA, rural farm	2.9	3.2	2.4	.8	.7	1.1	.9

1. Households owning two or more cars are counted once and are classified according to their latest model car.

Source: U.S. Department of Commerce, Office of Business Economics.

The effect of household income

Chart 11 shows how the automobile ownership rates for households in each income class vary from the mean ownership rates of all U.S. households. The bars indicate the differences from mean ownership before adjustment, and the points connected by the line indicate the differences after adjustment for the other five characteristics in the study.

In 1964, the mean ownership rate of one or more cars (77 percent, as was noted above) was attained at approximately $4,000 of income. On an unadjusted basis, differences from the mean ranged from −27 percentage points for households with incomes of under $2,000 to +20 percentage points for those with incomes of $15,000 or more. In other words, 50 percent of households with incomes under $2,000 and 97 percent of households with incomes of $15,000 or more owned at least one car. In the $6,000–$7,499 income class, nine-tenths of the households were automobile owners. Ownership rates continue to increase above this income but at a slower rate.

The adjusted differences were closer than the unadjusted differences to the mean ownership rate (table 3 and chart 11); this indicates that part of the variation in ownership rates by household income is caused by other characteristics. For example, the unadjusted difference between households with incomes of $10,000 to $14,999 and all households was 19 percentage points while the adjusted difference was 13. Thus, the slope of the adjusted differences is less steep than that of the unadjusted differences.

Removing the effect of housing tenure and employment status resulted in the most important incremental adjustments. In table 3, this can be seen by the fact that the figures in columns 6 and 7 are generally less close to those in column 3 than are the figures in columns 5, 8, or 9.

Ownership rates of two or more cars increased more rapidly with income than did ownership rates of one or more cars. On an unadjusted basis, about 9 percent of households with incomes under $2,000 were multicar owners. The rate fell to 6 percent in the $2,000–$3,000 income class but then increased steadily with income, reaching 60 percent among households with incomes of $15,000 or more. The mean rate—22 percent of all households—was approximated among households with incomes of $5,000 to $6,000.

Household income in this study shows current income, but automobile ownership is also influenced by past income. The income of many households may have been higher or lower at the time a car was acquired than in mid-1964, when the survey was conducted. In some cases, there may be a lag in the adjustment to current income; such a lag may explain why households with incomes under $2,000 have a higher multicar (and late model car) ownership rate than households with incomes of $2,000 to $3,000.

The strong upward movement in multicar ownership as income increased above the $2,000 level was lessened to some extent after the other five characteristics were accounted for; the adjusted differences ranged from −13 to

Table 2.—Proportion of Variance of Household Ownership of Automobiles Explained by Selected Household Characteristics, *Mid-1964*

Classes of households	Coefficients of multiple determination: Proportion of total variance explained by the characteristic(s)	Coefficients of multiple determination: Proportion of total variance explained by the characteristic and household income	Coefficients of partial determination: Proportion of residual variance [1] explained by the characteristic
Ownership of one or more cars			
Household income	.181		.054
Age of household head	.066	.200	.014
Employment status	.115	.216	.017
Housing tenure	.069	.214	.028
Residence by region	.016	.190	.006
Place of residence	.069	.246	.042
All six above	.304		
Ownership of two or more cars			
Household income	.138		.077
Age of household head	.046	.149	.019
Employment status	.038	.143	.002
Housing tenure	.047	.155	.013
Residence by region	.005	.143	.003
Place of residence	.029	.156	.016
All six above	.183		
Ownership of 1962–1964 models [2]			
Household income	.123		.083
Age of household head	.022	.125	.006
Employment status	.029	.127	.008
Housing tenure	.021	.127	.002
Residence by region	.004	.125	.002
Place of residence	.015	.130	.005
All six above	.139		
Ownership of 1957–1961 models [2]			
Household income	.029		.013
Age of household head	.018	.034	.005
Employment status	.017	.035	.001
Housing tenure	.003	.034	.004
Residence by region	.002	.031	[a] .001
Place of residence	.008	.037	.004
All six above	.049		
Ownership of 1956 and earlier models [2]			
Household income	.022		.022
Age of household head	.001	.023	[b] .001
Employment status	.001	.025	.003
Housing tenure	[b] .000	.023	.001
Residence by region	.006	.029	.005
Place of residence	.009	.029	.006
All six above	.039		

1. Residual variance is the variance remaining after accounting for the five other characteristics in the analysis.
2. Households owning two or more cars are counted once and are classified according to their latest model car.

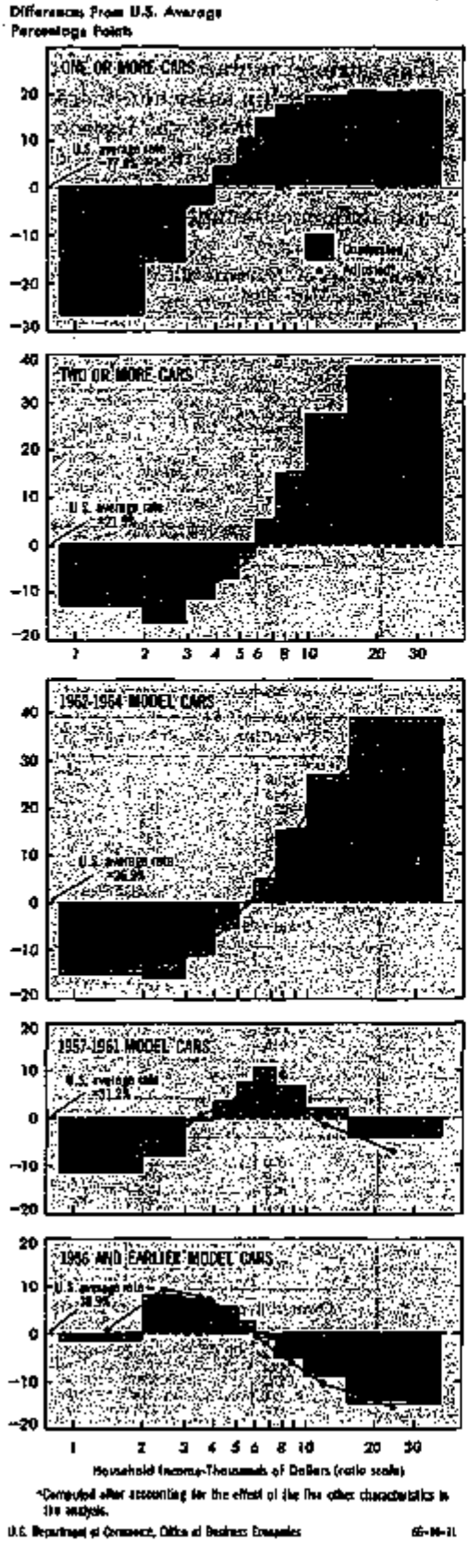
NOTE.—F tests showed coefficients significant at the 0.01 probability level except,
a. Significant at the 0.05 probability level.
b. Not significant at the 0.05 probability level.

Source: U.S. Department of Commerce, Office of Business Economics.

CHART 11

Auto Ownership Rates Among Households:

Unadjusted and adjusted differences from U.S. average, by household income, mid-1964



+32 percentage points, as compared with a range of −16 to +38 before adjustment (chart 12 and table 4, columns 1 and 2). Adjustment for housing tenure was the most important in the reduction of the slope.

Sharp gains in ownership rates with increases in household income were also found for cars less than 3 years old. The rate for all U.S. households in mid-1964 was 27 percent, reached at the $5,000 to $6,000 level of household income; the unadjusted rate was 39 percent above the mean among households with incomes of $15,000 or more. In contrast, the ownership rate of cars between 3 and 8 years old reached its maximum at $6,000 to $7,500 of household income and then fell steadily as income rose. The maximum ownership rate for cars 8 years old and older was reported by the $2,000 to $3,000 income group. It should be noted that households owning two or more cars are counted once and are classified according to their latest model car.

For cars less than 8 years old, differences from the ownership rates of all households were reduced after accounting for the five other characteristics in the analysis. For cars 8 years and older, the relationship between income and ownership was not appreciably affected.

Income elasticity

In order to investigate the effect of income on automobile ownership more intensively, income elasticities were calculated for households with $2,000–$15,000 income. The income elasticity of ownership measures the relation between the relative change in household income and the relative change in automobile ownership. Households with incomes less than $2,000 were not included because of the strong effect of past income on their ownership. Households with incomes over $15,000 were not included because of the very wide range of income variation among a relatively small number of households.

The elasticities were derived by fitting curves based on least squares regressions between the mean income of seven income classes of households and their auto ownership rates, after adjustment for the five other characteristics in the study.[6]

The results show that, over the $2,000–$15,000 income range, the elasticity is approximately constant with a value somewhat above one for ownership of two or more cars. The elasticity is approximately constant and somewhat below one for ownership of cars less than 3 years old. This means that for these two types of automobile ownership a 1 percent rise in household income is likely to be accompanied by a rise of roughly 1 percent in ownership.

In contrast, the income elasticity for ownership of one or more cars is only about 0.25 among households with incomes of less than $6,000 and is even smaller for higher income households.

For cars 3 to 8 years old, the income elasticity is about 0.40 for incomes under $4,000; it declines to zero as income approaches $7,500 and becomes negative at higher incomes. For cars 8 years old or older, the income elasticity is negative for all income classes tested.

Age of household head

Approximately 85 percent of households whose heads were between 25 and 54 years of age owned at least one car. Rates were lower among other households, especially among those with heads 65 years or over, whose ownership was 25 percentage points less than the mean. Thus, on an unadjusted basis, the pattern of auto ownership rates by age of household head takes the shape of an inverted U (chart 12). After adjustment for the influence of other household characteristics, however, the pattern by age approximates a straight line, which slopes downward as the age of the household head increases.

Although the unadjusted ownership rate of households with heads under 25 was only slightly above average, the adjustment for income effect increased the difference to 5 percentage points (table 3). After adjustment for all five characteristics, it was 9.5 percentage points above average, more than for any other age group. Income and home ownership—both of which

6. The equations used to calculate elasticities are available on request.

are relatively low among households with younger heads—contributed most to hide the strong underlying demand for auto ownership among young household heads (table 3). Factors in this demand—after adjustment for other characteristics studied—may be that other needs, particularly those arising from family obligations, are as yet less pressing and that there is a greater need for transportation for recreational and social purposes among these relatively young households.

Households with the oldest heads had the largest negative differences from the mean ownership of one or more cars, —25 percentage points before adjustment and —9 percent after. Household income and employment status contributed most to the large negative unadjusted difference, more than offsetting the reverse effect of the relatively high homeownership rate of households with heads aged 65 or over. The negative difference remaining after adjustment for all the characteristics included in this study may in part reflect a higher incidence of physical disabilities among older people.

Multiple car ownership rates were highest among households with heads 35 to 54 years old and were especially high in the 45–54 age group. The rankings of these age groups were confirmed by the adjusted differences and thus were not the result of the five other characteristics in the analysis. On the average, these households have the largest number of children of driving age, whose demand for cars tends to overcome competing budget demands of their families.

Ownership by age of car showed a varied pattern by age of household head. After adjustment, ownership rates of cars less than 3 years old were higher than average for the households with the youngest heads, lower for those with the oldest heads, and close to the mean for other age groups of households. The pattern for medium-age cars was similar to that for overall automobile ownership—i.e., adjusted ownership rates tended to decline as age increased. Age apparently had no effect on ownership of cars 8 years old or older, as both unadjusted and ad-

Table 3.—Household Ownership of One or More Automobiles by Selected Household Characteristics, Mid-1964: Differences From Mean Ownership Rate [1]

(Percentage points)

Classes of households	Unadjusted	Adjusted for		Adjusted for all characteristics except:					
		Household income only	All characteristics	Household income	Age of household head	Employment status of head	Housing tenure	Residence by region	Place of residence
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Household income									
Under $2,000	−26.7		−19.8		−21.1	−21.4	−22.0	−20.9	−19.2
$2,000–$2,999	−15.3		−9.5		−10.1	−11.0	−11.2	−9.7	−8.2
$3,000–$3,999	−3.1		−.8		−.8	−1.2	−1.9	−1.0	−.9
$4,000–$4,999	3.8		3.2		3.9	3.8	2.6	3.1	3.0
$5,000–$5,999	10.1		7.8		8.5	8.6	8.2	7.9	7.7
$6,000–$7,499	14.7		10.4		11.3	11.3	11.9	10.5	10.2
$7,500–$9,999	17.5		11.6		12.6	12.5	13.8	11.9	11.5
$10,000–$14,999	19.2		12.2		13.8	14.6	15.6	13.0	12.0
$15,000 and more	20.2		13.4		13.7	15.7	16.3	13.5	13.2
Age of household head									
Under 25	2.5	4.9	9.5	9.3		10.6	4.8	9.8	10.7
25–34	8.8	4.4	5.0	6.0		6.4	2.7	5.2	5.7
35–44	9.2	3.6	1.7	4.4		3.3	1.5	1.0	2.0
45–54	6.4	3.4	1.0	1.7		2.7	1.5	.0	.3
55–64	−1.6	−.3	−1.8	−3.2		−1.6	−.8	−1.9	−2.2
65 and over	−24.5	−12.9	−9.1	−14.3		−14.7	−0.7	−9.1	−8.9
Employment status of head									
Self-employed: Nonagriculture	13.1	10.6	8.7	9.4	9.2		10.2	8.7	8.2
Self-employed: Agriculture	9.0	16.8	6.6	8.4	8.4		7.9	7.3	11.8
Employee	7.4	3.0	2.2	4.7	3.8		2.1	2.1	2.0
Not employed	−24.6	−13.6	−9.5	−15.7	−13.6		−10.0	−9.0	−9.7
Housing tenure									
Homeowner	8.6	6.2	5.8	7.5	4.8	5.0		5.3	6.0
Renter	−13.9	−10.0	−8.6	−12.1	−7.1	−9.0		−8.7	−11.2
Residence by region									
New England	−1.0	−1.6	−2.1	−2.8	−3.5	−3.2	−4.1		.0
Middle Atlantic	−5.3	−10.3	−2.0	−1.0	−3.1	−2.0	−2.7		−8.5
East South Central	−6.8	1.1	−4.5	−8.4	−4.0	−4.7	−4.2		−1.6
South Central	.2	1.6	−2.5	−3.0	−2.1	−2.7	−2.4		.0
West South Central	1.1	5.2	1.9	−.3	2.3	2.2	2.2		3.3
East North Central	2.0	2.0	1.0	1.8	1.4	1.8	2.2		1.4
West North Central	3.9	6.8	2.1	1.5	1.9	2.7	2.7		4.2
Mountain	10.4	7.8	5.8	7.0	5.0	4.8	5.4		7.1
Pacific	5.4	1.9	3.4	5.3	3.7	3.0	2.0		3.7
Place of residence									
SMSA, central city									
Urbanized area 10,000,000 or more	−34.6	−36.4	−27.3	−25.5	−28.7	−27.0	−33.1	−30.4	
Urbanized area 3,000,000 to 9,999,999	−10.4	−15.7	−13.9	−12.3	−14.4	−14.4	−10.5	−13.0	
Urbanized area 250,000 to 2,999,999	−0.6	−5.7	−4.5	−4.2	−4.7	−5.0	−5.7	−4.0	
Urbanized area under 250,000	−1.9	−1.1	−.0	−.8	−.8	−.8	−1.4	−.3	
SMSA, noncentral city									
Urbanized area 3,000,000 or more	8.0	2.1	1.0	3.3	1.2	1.3	2.3	1.0	
Urbanized area under 3,000,000	11.2	6.9	6.2	7.6	6.5	5.0	7.4	5.9	
Outside SMSA's									
Urban	.1	1.8	1.8	1.2	1.0	1.8	1.9	2.0	
Rural nonfarm	2.0	6.7	5.2	2.5	5.3	6.2	6.7	4.8	
Rural farm	6.1	14.6	7.8	4.4	7.8	11.4	9.0	7.7	

1. The mean ownership rate in mid-1964 was 77.0 percent. The differences from this rate are based on the coefficients of the explanatory variables obtained from the regressions.

Source: U.S. Department of Commerce, Office of Business Economics.

justed differences were very close to the mean ownership rate of such cars.

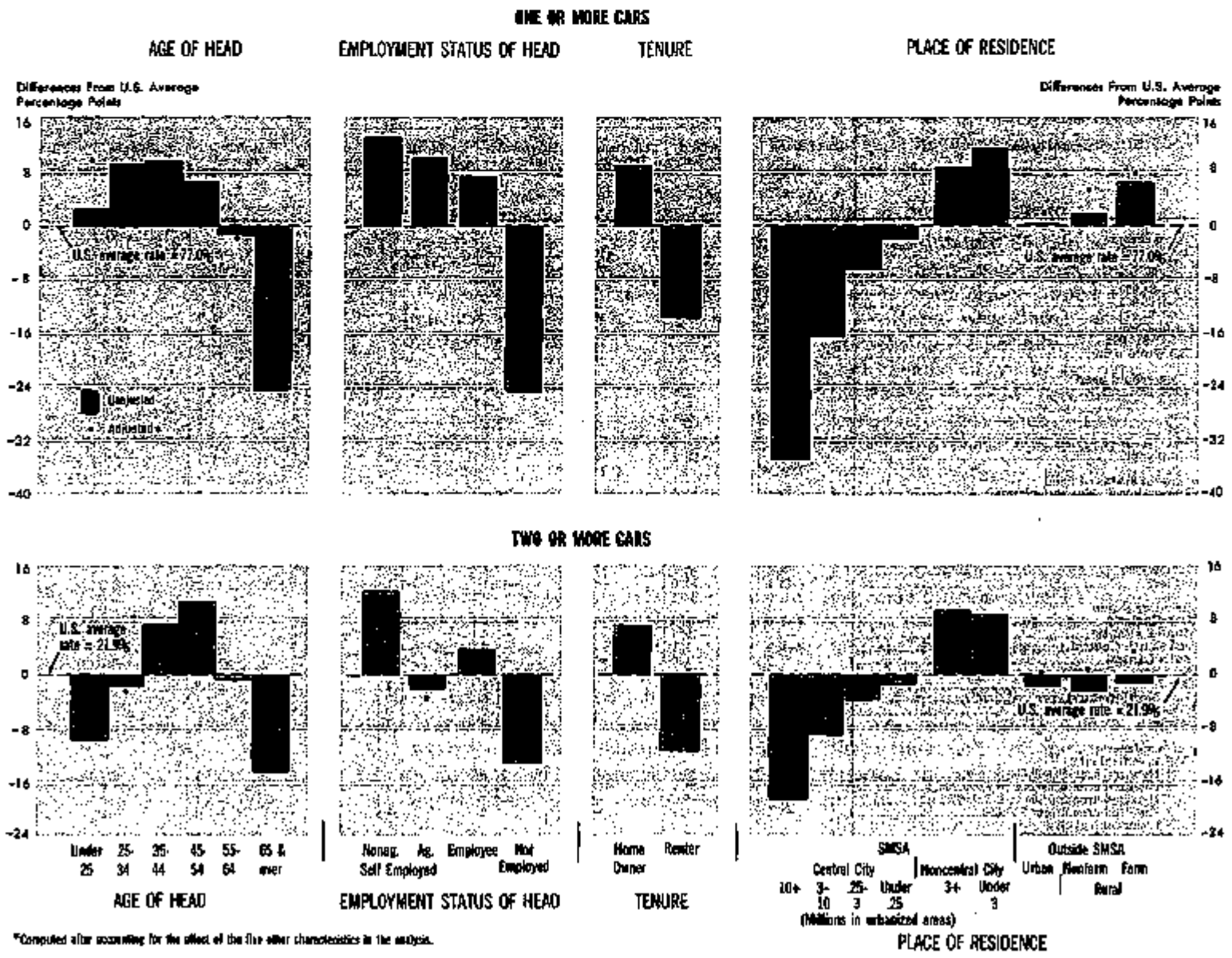
Employment status

As would be expected, households with self-employed heads had a higher rate of ownership of one or more cars than did those headed by employees; this was particularly true for the self-employed in nonfarm occupations. The lowest rate before adjustment, 25 percentage points below the mean, was found among households with heads who were not employed. The five other characteristics in the study accounted for part of these differences, but the ranking of the classes did not change after adjustment (chart 12). Income was generally the major factor, while the age effect was quite important for the "not employed" group, which contains a large proportion of household heads at least 65 years old. Accounting for place of residence was important for farmers. The relatively higher demand of the self-employed (other tested factors being equal) probably reflects their need for cars for business use.

Self-employed farmers had lower-than-mean rates of multicar ownership both before and after adjustment for other characteristics. A likely cause of the lower multicar demand by farmers is their high rate of ownership of trucks, which may substitute for a second automobile.

Auto Ownership Rates Among Households:

Unadjusted and Adjusted Differences



*Computed after accounting for the effect of the five other characteristics in the analysis.

U.S. Department of Commerce, Office of Business Economics

Housing tenure

Homeowners had considerably higher rates of automobile ownership than renters for each type of auto ownership studied, except for cars 8 or more years old (chart 12). Accounting for the other characteristics in the analysis generally reduced the differences but did not eliminate them. The reduction of the differences was due mainly to removing the effect of the higher income of the homeowners. The reduction also reflected the effect of place of residence, since homeowners are less likely to live in central cities, where automobile ownership is less frequent.

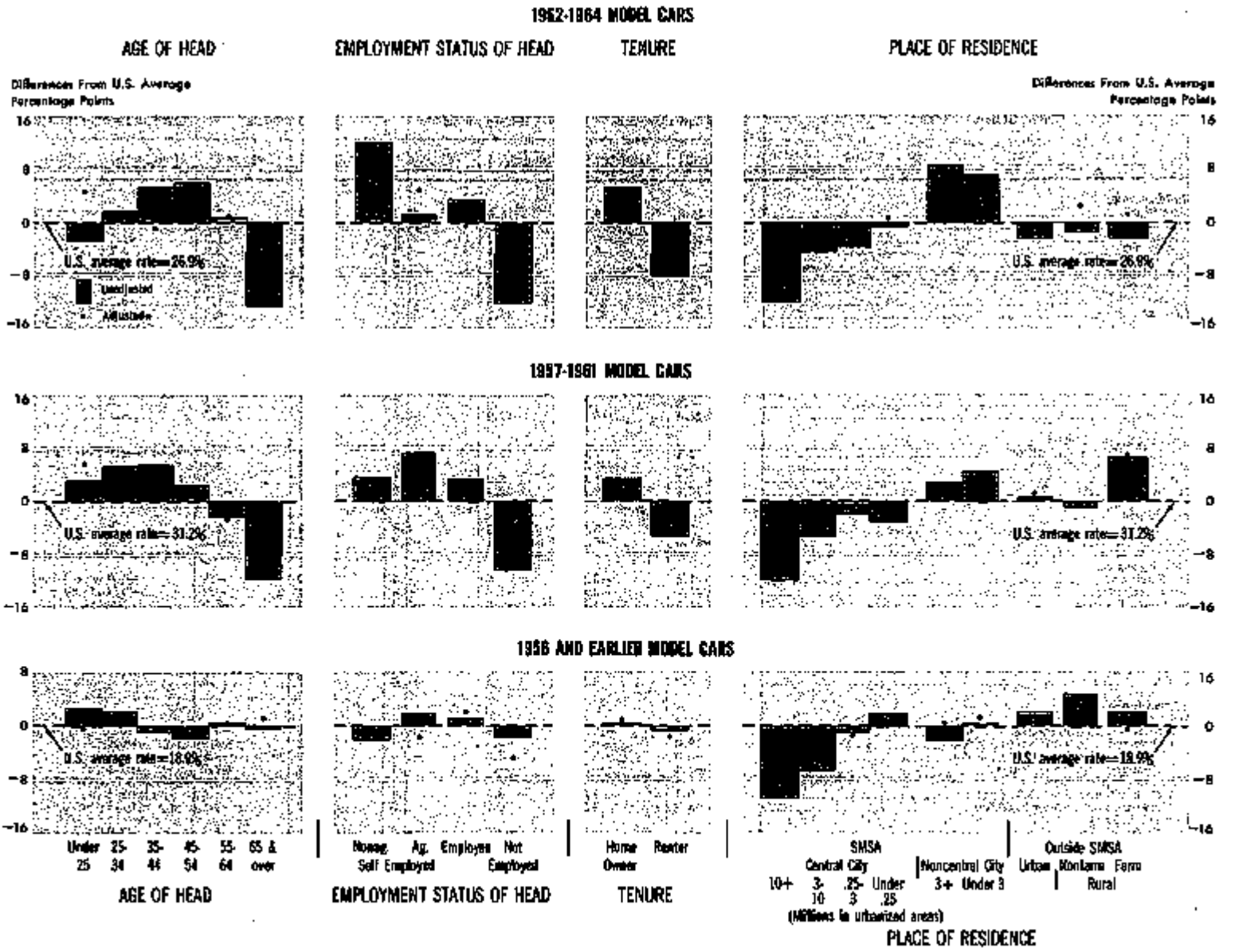
The higher demand for car ownership by homeowners on an adjusted basis may reflect the fact that the owner-occupied home is generally located further from the community's major area of activity than a rented dwelling; moreover, off-street parking and garages are available more readily and cheaply to the homeowner than to the renter.

Region of residence

Households in the Mountain States had the highest rate of ownership of one or more cars among the nine regions of the United States; their unadjusted rate was 10 percentage points above the mean. Above-average rates also existed in the Pacific, East North Central, and West North Central States. The lowest rates were found in the Middle Atlantic and East South Central States. However, a large part of the differences

CHART 12

From U.S. Average, by Selected Characteristics of Households, Mid-1964



among regions was found to be attributable to the other characteristics in the study. The high rate in the Mountain States and the low rate in the East South Central States were caused mainly by the income effect; the low ownership rate in the Middle Atlantic States was due mainly to a higher-than-average proportion of city dweller households. After adjustment, ownership rates were still above average in the Mountain and Pacific States and lower along the Atlantic Coast (table 3).

Multicar ownership rates were highest in the Western regions (close to 30 percent) and lowest in the Middle Atlantic, New England, and South Central regions (about 20 percent). This ranking remained virtually unchanged after the effects of other characteristics were accounted for (table 4). After adjustment, variations in ownership by region may be related (inversely) to the availability of public transportation facilities.

Classification of automobile ownership by region and age of car indicates that for cars less than 3 years old the East North Central region has the highest ownership rates and the East South Central region the lowest. These rankings remain unchanged after adjustment for the effect of other characteristics in the study. Michigan, which is one of the East North Central States, has the largest number of late model cars per household in the United States. This State is the center of the automotive industry and has more favorable auto prices because of lower freight costs and special discounts to automobile workers.

Place of residence

For most categories of automobile ownership, suburban households living in the Standard Metropolitan Statistical Areas (SMSA's) had higher rates than households living elsewhere; nearly nine-tenths of the suburban households were automobile owners and more than three-tenths owned a second car. The higher rankings of these households, as compared with those in central cities, were maintained after adjustment for

Table 4.—Household Ownership of Automobiles by Selected Household Characteristics, Mid-1964: Differences from Mean Ownership Rates[1]

[Percentage Points]

Classes of households	Types of ownership							
	Two or more cars		1962–64 models[2]		1957–61 models[2]		1956 and earlier models[2]	
	Unadjusted	Adjusted[3]	Unadjusted	Adjusted[3]	Unadjusted	Adjusted[3]	Unadjusted	Adjusted[3]
Household income								
Under $2,000	−12.8	−9.4	−15.0	−13.3	−11.0	−7.3	−0.8	0.0
$2,000–$2,999	−16.3	−12.3	−16.6	−14.0	−7.7	−4.3	3.0	9.5
$3,000–$3,999	−11.2	−9.3	−10.7	−9.9	−.1	1.0	7.7	8.1
$4,000–$4,999	−7.0	−6.9	−5.1	−5.2	3.3	2.9	5.7	5.6
$5,000–$5,999	−2.4	−2.9	.1	−.3	7.8	6.5	2.4	1.7
$6,000–$7,499	5.0	3.0	4.8	3.8	10.4	8.2	−.6	−1.0
$7,500–$9,999	16.1	11.4	15.8	14.1	6.7	3.6	−4.6	−4.0
$10,000–$14,999	27.3	22.7	26.5	24.8	1.9	−1.1	−9.2	−10.4
$15,000 and more	37.6	31.9	38.7	35.9	−8.3	−6.9	−14.7	−15.5
Age of household head								
Under 25	−9.8	−1.5	−2.9	4.2	2.9	6.5	2.5	−.2
25–34	−1.7	−2.2	1.6	.3	5.0	3.6	2.2	1.2
35–44	7.4	2.1	5.0	−.7	5.2	2.9	−1.0	−.8
45–54	10.7	6.7	5.8	1.9	2.3	.7	−1.8	−1.0
55–64	−.8	−.8	.4	.7	−2.3	−2.6	.2	.2
65 and over	−14.4	−6.0	−12.9	−3.6	−11.6	−6.5	−.1	1.0
Employment status of head								
Self-employed: nonagriculture	12.1	4.8	11.8	8.0	3.3	2.8	−2.1	−.2
Self-employed: agriculture	−2.0	−3.5	.8	4.4	2.3	3.4	1.7	−1.0
Employee	3.7	.6	3.2	−.4	3.3	.5	.9	2.9
Not employed	−13.3	−2.8	−12.4	−1.9	−10.4	−2.8	−1.9	−1.9
Housing tenure								
Homeowner	7.0	3.7	5.0	1.8	3.3	3.6	.3	.0
Renter	−11.6	−6.1	−8.1	−2.8	−5.4	−4.3	−.5	−1.3
Residence by region								
New England	−1.4	−3.2	.9	−.4	.0	−.5	−1.9	−2.4
Middle Atlantic	−4.4	−3.0	−1.5	−.8	−2.4	−.2	−4.3	−1.7
East South Central	−1.5	1.3	−7.8	−8.4	−4.4	−3.9	5.2	2.7
South Central	−.7	−.7	.8	1.1	−1.4	−2.5	1.0	−1.1
West South Central	−.7	1.3	−2.5	.2	−.1	.0	3.5	1.7
East North Central	.9	−.1	3.9	3.0	2.4	1.8	−6.3	3.2
West North Central	1.1	1.3	−1.8	−1.1	3.0	2.0	2.7	1.1
Mountain	4.9	2.4	3.0	.5	2.9	1.1	4.2	3.7
Pacific	5.9	3.2	.8	−2.3	.9	.3	3.7	5.4
Place of residence								
SMSA, central city								
Urbanized area 10,000,000 or more	−13.5	−13.5	−12.1	−10.3	−11.8	−9.2	−10.8	−8.4
Urbanized area 3,000,000 to 9,999,999	−9.0	−6.2	−4.4	−2.8	−5.3	−4.9	−6.3	−6.2
Urbanized area 250,000 to 2,999,999	−3.7	−2.5	−3.5	−2.4	−2.0	−.9	−.3	−1.2
Urbanized area under 250,000	−1.4	−.5	−.6	.4	−3.2	−2.7	1.3	1.7
SMSA, noncentral city								
Urbanized area 3,000,000 or more	9.1	1.0	8.1	.8	2.6	.5	−2.1	.4
Urbanized area under 3,000,000	5.8	4.0	6.9	3.9	4.2	2.3	.1	1.0
Outside SMSA's								
Urban	−1.6	.1	−2.0	−.6	.0	1.1	3.0	1.3
Rural nonfarm	−2.4	.5	−1.0	2.4	−.0	−.1	4.6	2.8
Rural farm	−1.1	3.5	−2.3	1.1	0.6	6.8	2.0	−.1

1. Mean ownership rates in mid-1964 were as follows: Two or more cars: 21.9 percent; 1962–64 model cars: 26.9 percent; 1957–61 model cars: 31.2 percent; 1956 or earlier model cars: 18.9 percent.
2. Households owning two or more cars are counted once and are classified according to their latest model car.
3. Adjusted for the effects of the five other characteristics in the study.

Source: U.S. Department of Commerce, Office of Business Economics.

other characteristics. However, households living in rural areas ranked even higher than suburban households in their demand for automobile ownership when the effects of other characteristics were removed (chart 12). On both an adjusted and an unadjusted basis, there was a clear relationship between auto ownership and the population size of an area: the larger the population, the lower the ownership rate.

In the suburbs of the largest SMSA's, most of the apparent difference in ownership rates between households living there and all households was accounted for by the other characteristics, mainly income and housing tenure.

In the largest central city—New York—household ownership of one or more cars was 35 percentage points below the U.S. mean, and only 3 percent of households owned a second car. These and other low rates in central cities were caused to some extent by the other characteristics in the analysis, mainly by homeownership, which is less frequent in central cities. However, after allowance for the other factors analyzed, rates substantially below average persisted in central cities in the more populous urbanized areas. Some of the causes of the negative adjusted differences from the mean may be the availability of mass transportation, limited parking facilities, and high insurance rates; the last two increase the cost of automobile ownership in the central cities relative to other areas.

Appendix

The results of this study were based mainly on mutivariate analysis carried out by least squares multiple regressions using dummy variables; all observations for both dependent and independent variables were coded either 1 or 0. For example, when the dependent variable was ownership of one or more cars, the value of 1 was attributed to a household if it owned an automobile, and 0 if it did not.

Each of the six explanatory characteristics was partitioned into mutually exclusive classes, and each class provided an independent variable for the regression. The household characteristics used in the analysis were partitioned

Appendix, Table A-1.—Summary of Five Regressions for Household Ownership of Automobiles, Mid-1964[1]

Explanatory variables (Classes of households)	Household ownership of									
	One or more cars		Two or more cars		1962–64 models		1957–61 models		1956 or earlier models	
	Regression coefficient	Standard error	Regression coefficient	Standard error	Regression coefficient	Standard error	Regression coefficient	Standard error	Regression coefficient	Standard error
Constant	77.3	1.4	13.0	1.5	23.2	1.7	37.7	1.8	15.4	1.6
Household income										
Under $2,000	−27.6	1.1	−6.8	1.2	−13.0	1.3	−13.5	1.4	−0.8	1.2
$2,000–$2,999	−17.3	1.3	−9.9	1.4	−13.7	1.5	−11.3	1.7	7.8	1.4
$3,000–$3,999	−8.6	1.3	−6.4	1.4	−9.6	1.5	−5.5	1.7	6.4	1.4
$4,000–$4,999	−4.6	1.3	−3.4	1.4	−4.9	1.5	−3.6	1.7	3.9	1.4
$5,000–$5,999 (omitted variable)										
$6,000–$7,499	2.0	1.2	5.9	1.3	4.1	1.4	1.7	1.5	−3.5	1.3
$7,500–$9,999	3.8	1.2	14.3	1.3	14.4	1.4	−2.9	1.5	−7.7	1.3
$10,000–$14,999	5.4	1.3	25.6	1.4	25.1	1.5	−7.6	1.6	−12.1	1.4
$15,000 and more	5.6	1.5	34.8	1.9	33.2	2.1	−13.4	2.3	−17.2	1.9
Age of household head										
Under 25	7.8	1.4	−2.6	1.5	4.9	1.6	2.6	1.8	0.3	1.5
25–34	3.3	.9	−4.4	1.0	1.0	1.1	0.7	1.2	1.7	1.0
35–44 (omitted variable)										
45–54	−0.7	.9	4.6	1.0	3.6	1.0	−2.2	1.2	−1.1	1.0
55–64	−3.5	1.0	−2.9	1.0	1.4	1.1	−5.5	1.2	0.4	1.0
65 and over	−10.8	1.1	−1.8	1.3	−2.9	1.3	−9.4	1.4	1.5	1.2
Employment status of head										
Self-employed: Nonagriculture	6.5	1.1	4.2	1.1	6.4	1.2	2.3	1.4	−2.2	1.2
Self-employed: Agriculture	4.4	2.0	−4.1	2.1	5.0	2.3	2.9	2.5	−3.6	2.3
Employee (omitted variable)										
Not employed	−11.7	.9	−8.4	1.0	−1.5	1.0	−3.3	1.1	−6.9	1.0
Housing tenure										
Homeowner	13.9	.7	9.3	.7	4.6	.8	6.9	.9	3.4	.7
Renter (omitted variable)										
Residence by region										
New England	−4.7	1.3	−8.1	1.4	−3.4	1.5	−2.1	1.7	0.8	1.4
Middle Atlantic	−4.3	1.0	−2.9	1.1	−3.8	1.2	−2.0	1.3	1.5	1.1
East South Central	−6.1	1.4	1.9	1.4	−0.4	1.6	−5.6	1.7	5.9	1.5
South Central	−4.1	1.0	−0.5	1.1	−1.9	1.2	−4.3	1.3	2.1	1.1
West South Central	0.3	1.2	1.4	1.3	−2.8	1.4	−1.8	1.5	4.9	1.3
East North Central (omitted variable)										
West North Central	0.5	1.2	1.9	1.3	−4.1	1.4	0.2	1.6	4.3	1.4
Mountain	6.7	1.5	2.5	1.7	−2.5	1.8	−0.7	2.0	5.9	1.7
Pacific	1.8	1.0	3.3	1.1	−5.8	1.2	−1.5	1.3	6.6	1.1
Place of residence										
SMSA, central city:										
Urbanized area 10,000,000 or more	−23.3	1.7	−9.9	1.8	−7.9	2.0	−8.3	2.2	−7.2	1.9
Urbanized area 3,000,000 to 9,999,999	−8.4	1.4	−3.6	1.5	−0.4	1.8	−4.0	1.8	−5.0	1.5
Urbanized area 250,000 to 2,999,999 (omitted variable)										
Urbanized area under 250,000	3.9	1.3	2.1	1.4	2.8	1.5	−1.8	1.7	2.9	1.4
SMSA, noncentral city:										
Urbanized area 3,000,000 or more	6.1	1.3	4.2	1.4	3.2	1.5	1.4	1.7	1.6	1.4
Urbanized area under 3,000,000	10.7	1.0	7.3	1.0	5.3	1.1	3.2	1.2	2.3	1.1
Outside SMSA's:										
Urban	6.3	1.1	2.7	1.1	1.8	1.2	2.0	1.4	2.5	1.2
Rural nonfarm	9.7	1.1	3.1	1.1	4.8	1.2	0.8	1.4	4.0	1.2
Rural farm	12.4	1.8	6.1	1.9	3.5	2.1	7.7	2.3	1.1	2.0

1. The coefficients are differences in percentage points from the ownership rate of the omitted variables. The constant of the equation is the expected ownership rate of households belonging to the six omitted classes.

Source: U.S. Department of Commerce, Office of Business Economics.

into 39 independent variables in all. For example, the division of the United States into nine regions provided nine separate variables. Each household was coded 1 in the variable for its region of residence and 0 for each of the other regions. The partitioning of the characteristics was as follows:

Characteristics related to automobile ownership of households	Number of classes (Number of independent variables)
Household income	9
Age of household head	6
Employment status of the head	4
Housing tenure	2
Residence by region	9
Residence by size of place	9

The dummy variables made it possible to use such nonnumerical variables as employment status or residence by region. The observations were coded 1 or 0 even for such characteristics as household income and age of the household head, for which numerical values of the observations were available. An advantage of the dummy variable technique is that the underlying relationship between the dependent and independent variables can be determined without requiring an *a priori* assumption about the form of the relationship.

The regression equations

Each of the five categories of automobile ownership was related to the classes of the six explanatory characteristics in a series of 18 equations. The first six equations used variables based on classes from a single characteristic. The regression coefficients from these six equations indicate for each characteristic the unadjusted differences from the mean U.S. rate of automobile ownership.

The next five regressions used household income and one of the other five characteristics since earlier studies had indicated the unique position occupied by income as an explanatory variable. Then, six regressions containing all combinations of five characteristics were computed. Finally, one equation was computed that included all six tested characteristics.[7] This final equation, in conjunction with the previous six equations, yielded the coefficients of partial correlation shown in table 2.

Transformation of the parameters

The use of the dummy variables requires the imposition of additional constraints on the parameters. In the original computations of these regressions, all households in one class of each characteristic were coded 0; this class is labeled "omitted variable" in table A–1. The constant in each of these regression equations is thus equal to the mean value of the dependent variable (rate of ownership, actual or expected) for all households belonging to the omitted class or classes. The coefficients of the independent variables are differences from the rate of ownership of the omitted class of households.

In order to interpret the results more easily, the constant and the coefficients of each equation were transformed so that the constant became equal to the mean ownership rate of all households and the transformed coefficients became differences (deviations) in percentage points from the mean ownership rate.[8]

Standard errors

The results of the original computations for the five regressions containing all six characteristics and standard errors of the coefficients before the transformation are shown in table A–1. These standard errors may serve in a rough test of significance of differences between any two of the original or transformed coefficients. The standard errors were very stable in each combination of independent and dependent variables whether or not other characteristics were included in the analysis.

1966 Model Autos

(Continued from page 19)

the 1966 market, as compared with 45 percent in 1965 and 30 percent in 1963. This growth, which has occurred in both 2- and 4-door hardtops, has taken place mostly at the expense of 2- and 4-door sedans, but there has also been some slippage for convertibles and station wagons. The sedans declined from 50 percent of the 1963 models to under 35 percent of the 1966 models.

More demand for extra equipment

In addition to trading up in price lines, consumers have been taking increasing numbers of the options offered with new cars. Among the higher cost options, for example, over 29 percent of the cars produced in the first 9 months of the 1966 model year had factory-installed air conditioners; 23 percent of the 1965 models were so equipped.

Another item growing rapidly in popularity is the vinyl-covered top, which was introduced in the 1964 models. Five percent of the 1965 models and 12 percent of the 1966 models were purchased with vinyl tops. Fully 84 percent and 67 percent of the 1966 cars were equipped with automatic transmissions and power steering respectively, as compared with 80 percent and 60 percent of the 1965 models. V–8 engines were installed in 78 percent of the 1966 models; this figure has been rising 5 to 6 percentage points a year since it reached 56 percent in 1962.

The increased demand for these and other factory-installed extras in the 1966 models, as well as the trading up to higher priced cars, more than offset the decline in the Consumer Price Index in their effect on average unit prices.

Trends by size of car

The share of the market accounted for by the compacts has continued to decline—to 17 percent in 1966 as compared with 22 percent in 1965 and a peak of 34 percent in 1962 (table 3). The standard sized cars have also been trending downward from more than 67 percent of the market in 1960 to 53 percent in 1965 and 52 percent in 1966.

Since 1963, these reductions have been offset by the movement toward the intermediate sized cars (chart 9). The intermediates accounted for 24 percent of the domestic output and imports of 1966 models, up from 19 percent a year earlier. The sport-type compact, after rising from a 2 to 3 percent range in the 1961–63 period to 9 percent in 1965, slipped back 1 percentage point among the 1966 models.

7. Tables showing the adjusted differences (similar to those shown in table 3) for the other categories of automobile ownership are available upon request.

8. For the method of calculation, see E. Melichar, *op. cit.*, p. 375.

U.S. GOVERNMENT PRINTING OFFICE: 1966—O-231-352